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CREDIT-USE AND TECHNICAL EFFICIENCY AMONG SMALLHOLDER BANANA PRODUCERS IN SHEEMA DISTRICT, UGANDA

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ABSTRACT

Credit use among smallholder banana farmers is reportedly on the rise though with a high rate of loan repayment default in Sheema District. However, research has not responded to this challenge to ascertain whether these farmers use credit capital efficiently. Using a representative sample of 90 households, technical efficiency of credit-using banana farmers was estimated within the Cobb-Douglas production Function framework. Results of the Stochastic Production Frontier Analysis (SPF) revealed that banana producers were highly efficient, though 90% of the total variation in output was arising from technical inefficiency rather than random variability. Credit capital and labour, as factors of production exhibited decreasing returns to scale. In the sample, if the average and least-efficient farmers adopted best practices of their most-efficient counterparts, their output and income streams would improve by 22.8% and 41.3% respectively. Post-secondary education, plot size for bananas and farming experience were identified as the major factors that would significantly reduce technical inefficiency. Overall, the current production technology in the banana farming system still needs a lot of improvement if credit capital is to be used efficiently. The study recommended searching for more productivity-enhancing technologies, extension training on credit management and appropriate agro-chemical use.

KEYWORDS: Credit Use, Production Elasticities, Sources of Technical Inefficiency, Uganda

INTRODUCTION

Background

Banana (*Musa spp*) is the fourth most important crop globally with approximately one-third produced in sub-Saharan Africa, where it provides more than 25% of food energy requirements for over 100 million people (FAO, 2006). The types of banana produced and traded include Matooke (cooking), Bogoya (plantain), Apple banana (dessert), Cavendish and Gros michel (Nsabimana *et al*., 2008). Among these, the East African highland cooking banana is the most important staple crop in the East African Great Lakes region, which includes Uganda, Tanzania, Burundi and eastern DR Congo (Bagamba *et al.,* 2010). Bananas are mainly grown for home consumption under very low-input regimes and household labor. Other important uses incomes to households tending to commercialize, animal fodder and brewing. However, a major challenge experienced in the banana sub-sector is declining farm-level yields, largely attributed to soil fertility exhaustion, pest and disease build-up following long periods of cultivation without rotation and inferior production methods. This situation is unlikely to change in the near future.

Although research has responded to the above challenge with a host of biological and physical science studies, there is only a few economics leaning studies in this sub sector. Among the economics studies, Bagamba *et al*. (2010), examined bananas along with other crops in Central and Western Uganda. The study led to the conclusion that there was a shift in resource allocation in favor of crops most suited to satisfying household food needs (e.g., sweet potato, cassava and

beans) against those that appear to be more profitable (e.g., bananas) when valued at farm-gate prices. Nakato *et al.* (2013) assessed the risk of Banana *Xanthomonas* wilt spread through trade samples of banana fingers and rachis from markets within Kampala, Uganda and at border points of Uganda with DR Congo, Tanzania, Rwanda and Kenya. Bagamba (2007) examined technical efficiency along with characterization of banana farmers in Central and Western Uganda. The study found out that the three regions: Central, Masaka and Southwest in Uganda, exhibited different technologies, which influenced labour use intensity.However, the Bagamba *et al* study did not consider measuring the efficiency of credit use as capital in production of bananas, rather regressed credit access against the measure of technical inefficiency. The current study thus undertook to specify a Cobb-Douglas production function and estimated the credit capital associated technical efficiency.

Nwankwo (2013) observed that the role of financial capital as a factor of production to facilitate economic growth and development, particularly focusing on alleviation credit constraints of poor rural farmers could not be over emphasized. Furthermore, Olatomide and Omowumi (2011) contended that the smallholders, already caught in the quagmire of the vicious cycle of poverty, requires not only labour or land but also an injection of capital to extricate them from that cobweb. Credit (capital) is viewed as more than just another resource such as labour, land, equipment and raw materials (Raji, 2008). However, when a farmer is granted a loan, so many other things must go with it before the loan can turn out be a productive instrument. Apart from the fact that agriculture is constrained by natural forces, farmers' attitudes with respect to the use of loan is also an important factor (Olatomide and Omowumi, 2011), which essentially determine its use efficiency and overall productive efficiency.

Case *et al.* (2009) defined efficiency as the condition in which the economy is producing what people want at least possible cost. The concept of efficiency is primarily concerned with the relative performance of the processes used in transforming given inputs into outputs. These are three types of production related efficiencies namely: allocative, technical and economic efficiencies. Allocative efficiency refers to the choice of the best combination of inputs consistent with the relative factor prices. That is, allocative efficiency is the ability of a firm to use inputs in optimal proportions, given their respective prices. Technical efficiency (TE) shows the ability of firms to employ the 'best practice' in an industry, so that no more than the necessary amount of a given sets of inputs is used in producing the best level of output. TE is based on the principle of attainment of the production goal without waste (Olarinde *et al.,* 2008).The product of technical and allocative efficiencies yields economic efficiency.

Technical efficiency refers to the physical ratio of product output to the factor inputs. The greater the ratio, the greater the size of the technical efficiency. This implies the existence of variation in technical efficiency among firms or farms. The estimation of technical efficiency is based on the premise that if the observed output at current level of technology is a result of low technical efficiency, it is better to retain the existing technology and work on improving the technical efficiency. TE is measured using either non parametric or parametric methods. Non-parametric methods rely on linear programming methods and assume that all deviations from the frontier are the result of technical inefficiency. However, this simple deterministic model takes no account of the possible noise upon the frontier. On the other hand, parametric methods depend on specifying production functions most commonly; the Cobb–Douglas, Constant Elasticity of Substitution (CES) or translog production functions and estimating their parameters using econometrics (Chirwa, 2007). In this study, efficiency was estimated using Cobb –Douglas stochastic production frontier.

Several scholars have investigated the relationship between efficiency and various socio – economic variables using two alternative approaches (Bravo – Ureta and Pinheiro, 1993). One approach is to compute correlation coefficients or to conduct other simple non - parametric analyses. The second way, usually referred to as a two-step procedure, is to first measure farm- level efficiency and then to estimate a regression model where efficiency is expressed as a function of socio – economic attributes. All these methodologies of analysis have been a subject of criticism by various authors. However, Kalirajan (1991) defended the two – step procedure by contending that the socio – economic attributes have a roundabout effect on production and hence, may not be incorporated into the model directly. Consequently, the two-step procedure has continued to be a popular approach in agricultural economics research and is further adopted in the current study.

Rahman *et al.* (2011) noted that it is difficult to establish a causal relationship between agriculture credit and production due to the existence of critical endogeneity problem. The authors argued that credit does not affect the output directly but rather it has an indirect effect on output through easing the financial constraints of the producers in purchasing inputs. In contrast, Sriram (2007) argued that increased supply and appropriately administered pricing of credit help in increasing agricultural productivity and the well-being of farmers. Whether credit capital is associated with technically efficient banana output and productivity or not, is an empirical question, that previous research has not satisfactorily resolved. Consequently, the high rate of loan repayment default among smallholder farmers motivated the current study to empirically test for credit capital associated technical efficiency. Findings of this study are not only important in guiding farmers on cautious use of credit capital for safe repayment of loans but also contributing to defining the scope for public investment that guarantees enhanced competitiveness of the banana sub-sector.

Theoretical Framework

Carter (1989) posited that credit affects the performance of agriculture in three ways: First, it encourages efficient resource allocation by overcoming constraints to purchase inputs and use them optimally. Secondly, if the agricultural credit is used to buy modern farm technology, it shifts the entire input-output frontier. In this regard, it embodies technological change and a tendency to increase efficiency of the farmers. Thirdly, credit can also increase the use intensity of more fixed resources like land, family labor, and management. Therefore, following the Rahman *et al*. (2011) methodology, this study used agricultural credit as an independent variable in the Stochastic Production Frontier (SPF) Model. Meeusen and van den Broeck (1977) and Aigner *et al.* (1977) separately and simultaneously proposed the SPF. It is a parametric and econometric approach with properties of separating the effects of noise from the effects of inefficiency and it confounds the misspecification of the function form with technical inefficiency (Khai ad Yabe 2011). The SPF is specified as shown in equation (1):

$$Y_i = f(\beta_i, X_i) + \varepsilon_i \tag{1}$$

Where Y_i represent the observed level of output. β_i and X_i are vectors of parameters to estimated and inputs used in the production process. ε_i is the error term that consists of two components; $\varepsilon_i = V_i - U_i$. The component V_i is symmetric, allows random variation of the production function across farms, and captures the effects of statistical noise, measurement error and exogenous shocks beyond the control of the producing unit. V is assumed to be normally distributed with mean zero and constant variance $(V \sim N(0, \sigma_v^2))$. On the other hand U_i is one-sided error term that

captures non – negative random variables and technical inefficiency (TI). If $U_i = 0$, production lies on the stochastic production frontier and is considered efficient while if $U_i > 0$, then production lies below the frontier and thus inefficient.

The error term U_i is usually assumed to follow one of three possible distributions (Lee, 1983; Schmidt and Lin, 1984; Bauer, 1990): normally distributed half normal, normally distributed exponential and normally distributed truncated. According to Okuruwa and Ogundele (2006), any of the three distributions could be used, since estimates of technical efficiency are similar in all distributions. In the current study, the truncated normal approach was preferred because of its properties of concurrent estimation of gamma (γ) with technical efficiency. Jondrow *et al.* (1982) showed that technical inefficiency for each observation is calculated as the expected value of U_i conditional on $\varepsilon_i = V_i - U_i$ *i.e.*

$$E(U_i \mid \varepsilon_i) = \sigma^{*2}\left[\frac{f^*(\varepsilon_i\lambda/\sigma)}{1-F(\varepsilon_i\lambda/\sigma)} - \frac{\varepsilon_i\lambda}{\sigma}\right] \tag{2}$$

Where $\sigma^{*2} = \frac{\sigma^2{}_v\sigma^2{}_u}{\sigma^2}$, f^* is the standard normal density function, F is the distribution function and both functions being estimated at $\frac{\varepsilon_i\lambda}{\sigma}$. Battese and Corra (1977) observed that depending on the assumption of the random errors, the maximum likelihood single stage estimation procedure for estimating the parameters of the frontier model, inefficiency model and the farm-specific TE defined by the measure of efficiency of technical efficiency model are obtained by the parameterization: $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and;

$$\gamma = \frac{\sigma_u^2}{\sigma^2} = \frac{\sigma_u^2}{\sigma_v^2 + \sigma_u^2} \tag{3}$$

Where σ^2 is total variation, σ_v^2 is variation resulting from the stochastic noise and σ_u^2 is variation arising from the inefficiency. If $\gamma = 1$, it implies that variance from the frontier is wholly due to inefficiency while $\gamma = 0$, it means that variance from the frontier totally comes from noise effects. Thus, for output variation to be attributed to stochastic errors and technical inefficiency, then the condition for distribution of variation must be $0 < \gamma < 1$.

METHODOLOGY

Study Area

The study was carried out in August 2012 in two sub counties of Sheema District, Uganda, namely: Kyagyenyi and Kagango. In this study area, majority of the population derive their livelihood from cattle keeping as their traditional economic activity. Recently, there has been an increased shift to cooking banana production and a significant number of residents tending to smallholder commercialization. This kind of production can be attributed to high amount of annual rainfall (of bimodal pattern) received in area. In addition, a considerable number of these banana producers have of late increasingly demanded credit for production though with a high rate of default.

Data Sources

Primary data was obtained using a purposive and systematic sampling procedure. For purposes of sampling, three strata were created to serve as sampling frames from which a representative sample of 92 respondents was drawn. The first

stratum consisted of households using micro-finance credit popularly known as Savings and Credit Cooperative Organization (SACCOs) whose registration is undertaken by the District Commercial Office (DCO). Lists of borrowers of varying lengths ranging from 6 – 9 for the cropping season of August 2011 to July 2012 were collected from nine SACCOs. These lists were subjected to systematic sampling of picking every even number on each list and this process yielded a sample of 68 households who were all interviewed, though 1 respondent's questionnaire was dropped due to inconsistency in data. The second stratum comprised of households relying on informal groups savings for source of credit commonly referred to Village Loans and Savings Associations (VLSA). To obtain VLSA members, two parishes were randomly selected from each of the above sub counties followed by selection of three villages. From each village, chairpersons of LCI were asked to identify all VSLAs operating in the village along with their contact persons. These contact persons were then asked to provide two lists namely: a list of members known to them who had borrowed from the groups' savings and another those members that had used bank credit in the cropping seasons stated above. The category of VLSA created a sample of 15 respondents who were all subjected to interview because of their small number. However, one respondent's data was inadequate and was dropped from final analysis, limiting the stratum sample to 14 respondents. The category of bank credit users formed the third stratum who were 9 in total and were all interviewed for the reason explained above. In summary, the whole process yielded a final sample for analysis of 90 respondents. Data was collected using a pre-tested and structured questionnaire which had both close – ended and open – ended questions. Open – ended question were mainly for capturing quantitative data with units of measurements specified for the respondents. There were also questions, which gave respondents freedom of expression. Close-ended questions were mainly for qualitative data and presented options from which respondents made a choice for those that best described their situation. In case, none of the provided options described the respondent's situation an alternative of 'other specify' was provided for production related data, respondents were requested to recall and estimate the average quantity of small and large size banana bunches both harvested and sold for the reference-cropping season of July 2011 to June 2012. Using, the estimates, the annual production levels were calculated. Furthermore, respondents were asked to give an estimate of average prices for small and big size banana bunches for the reference period. Farmers also reported the amount of credit they had obtained from their lenders during the reference period. Other data categories collected included the education level of household head, age of household, farming experience, sex, labour including family and hired labour, household size, farmland size, plot of land allocated to banana production and use of agro-chemicals among others.

Analytical Methods

Consider a profit maximizing economic agent producing banana output (Y) using capital / credit (K), land (L) and Labour (X). The production technology would then be defined by the Cobb-Douglas Production as shown in equation (4):

$$Y = f(K, L, X) \tag{4}$$

However, literature has also shown that the level of production is influenced by the marketable surplus since part of the income from marketing activities of the producer can be re-invested in more production by purchase of variable inputs. Secondly, output arising from increased investment in variables can be enhanced by observed market prices at a particular point in time. Therefore, in linearized form, the stochastic production frontier can be represented as in equation (5):

$$\ln Y_i = \beta_0 + \beta_i \ln(X_i) + V_i - U_i \tag{5}$$

Where X_i contains production inputs (Credit, Farmland Size, Labour) and other factors such as Quantity sold in the cropping season and Average price of banana bunches. ln means natural logarithms, all variables were linearized using the natural logarithms so that the resultant regression coefficient are interpreted as elasticities and explained as percentage change in the dependent variable in response to the percentage change in the explanatory variables. Due to anticipated endogeneity problem associated with econometric estimation of endogenous variables when included among the explanatory variables, predicted values of linearized credit variables were entered in the SPF regression instead of the credit variable. First, a regression model of determinants of credit use (results shown in Appendix A) was run as indicated in equation (6) and this was followed by predicting values of credit i.e.

$$\ln Credit_i = \alpha_0 + \alpha_{1,i} \ln Ban\_Land_i + \alpha_{2,i} \ln Hrd\_Labour_i + \alpha_{3,i} \ln Far\_Exp_i + \alpha_{4,i} \ln HH\_Age_i + \alpha_{5,i} DAgro\_Chem_i + \alpha_{6,i} DEduc_i + \varepsilon_i \tag{6}$$

Where $Credit$ represent credit amount acquired by the banana producer during the cropping season in Uganda shillings, Ban_Land is plot land size allocated to banana production in acres, Hrd_Labour is hired labour in number of persons employed on the farm during the cropping season, Far_Exp is level of farming experience of the household head in years. Others are HH_Age, the age of the household head in years and $DAgro\_Chem$, a dummy variable taking on the value of one if the household used agrochemicals during the reference period and zero if otherwise. $DEduc$, a dummy variable for education which is equal to one if the household head had attained level of post primary education and zero, if otherwise. α_j are the various coefficients to be estimated by the model (where j = 1,2,….6). ε, the error term and i, the i^{th} household in the sample. From equation (6), predicted values of credit were obtained as:

$$Credit\_hat = predict(\ln Credit), xb \tag{7}$$

Therefore, the empirical stochastic Production frontier was specified as shown in the equation (8) below:

$$\ln Ban\_Output_i = \beta_0 + \beta_{1,i} Credit\_hat_i + \beta_{2,i} \ln Farm\_Size_i + \beta_{3,i} \ln HH\_labour_i + \beta_{4,i} \ln BanQty\_Sold_i + \beta_{5,i} \ln Av\_Price_i + V_i - U_i \tag{8}$$

Where V and U are as explained in equation (1). $Farm\_Size$, farmland size in acres; HH_Labour, total household labour which is the sum of hired and family labour; $BanQty\_Sold$, number of banana bunches sold during the cropping season as explained above. Av_Price, the weighted average price of banana bunches for each individual observation computed as follows:

$$AV\_Price = \left[\left(\frac{Qty_S}{Qty_T} \right) * P_S + \left(\frac{Qty_L}{Qty_T} \right) * P_L \right] \tag{9}$$

Where Qty_S, Qty_L and Qty_T, represent quantity of small, large and total banana bunches produced respectively while P_S and P_L represent reported average price for small and large banana bunches respectively.

A priori expectation of signs of the coefficients in the empirical framework in equation (8) estimated using Maximum likelihood Model of production frontier is $\beta_j > 0$ where $j = 1,2,...5$ because all the predictors are theoretically expected to increase overall output.

Determining Sources of Technical Inefficiency

To determine the major sources of technical inefficiency, factors that have reported to affect farmers' efficiency were regressed against predicted values of U_i. The factors, which have been identified from literature (see Olarinde *et al*., 2008; Ogundele and Okuruwa, 2006) and that are re-examined in this study include Labour (Hrd_Labour; number of hired labourers during the cropping season) and Sex (HH_Sex; equal to one if household head is male and zero otherwise). Others were education level ($PostSec\_Educ$; if a household head had attained post-secondary education and zero otherwise), household size (number of members) and farmers' experience (number of years in farming). In addition, two variables that are characteristic of banana production were included namely: Agro-chemical ($Agro\_Chem$; equal to one if household used agro-chemicals in the cropping season and zero otherwise) and land plot size allocated to banana production in acres (Ban_Land) as shown in equation (10):

$$U_i = \delta_0 + \delta_{1,i} \ln Ban\_Land + \delta_{2,i} \ln Far\_Exp + \delta_{3,i} \ln Hrd\_Labour + \delta_{4,i} \ln HH\_Size + \delta_{5,i} PostSec\_Educ + \delta_{6,i} DAgro\_Chem + \delta_{7,i} Sex + \varepsilon \tag{10}$$

Sign expectations of the variables: $\delta_j > 0$ if it exacerbates technical inefficiency, $\delta_j < 0$ if it reduces technical inefficiency and $j = 0,1,2...7$.

RESULTS AND DISCUSSIONS

Technical Efficiency Estimates

Estimates of the stochastic production frontier of are presented in **Table 1**. The results showed that the variables of credit capital, Household labour, marketable surplus, and output price, all conformed to theoretical expectation of positive signs. Apart from the output price that was not significant, the rest of these variables were all statistically significant at 1%. The only explanatory variable that deviated from theoretical expectation was size of farmland. Never the less, it was not significant at any level. The estimate of sigma-square (σ^2) was 0.07, indicating significant difference from zero, and therefore good fit and correctness of distributional assumptions specified in the model for credit-using banana producers. Estimated gamma (γ) that measures the effect of technical inefficiency in the variation of observed output was 0.90. This meant that 90.0% of the total variation in banana output associated with credit use was due to technical inefficiency and not related to random variability. Thus, the effects of technical inefficiency are not only statistically significant but also economically important to scrutinize in the overall sample. The policy implication of this high level of variation in output due to technical inefficiency is that a big number of smallholder banana producers could be unknowingly at high risk of credit repayment default. It thus important to assess the like causes of inefficient production

associated with credit use. This study could not rule out reliance on inferior farming technologies that lead to sub-optimal output or improper use of credit including diversion of such credit to non-productive activities as possible causes of this inefficiency.

Table 1: Stochastic Frontier Analysis of Technical Efficiency

Explanatory Variables	Dependent Variable: lnBan_Output			
	Co-Efficient	Standard Error	z-Value	p-Value
Credit_hat	0.24	0.045	5.26	0.000
lnFarm_Size	-0.07	0.050	-1.37	0.169
HH_labour	0.06	0.015	4.32	0.000
lnBanQty_Sold	0.27	0.046	5.92	0.000
lnAv_Price	0.08	0.101	0.83	0.409
Constant	1.89	1.022	1.85	0.065
Sig-Square(σ^2)	0.07			
Gamma (γ)	0.90			
Observations	90.00			
Wald χ^2	155.47			
LR	48.48			
Prob > χ^2	0.0000			

Overall, the estimated production elasticities were very small raising environmental sustainability concerns of use of credit capital in banana farming system in the area at current level of technology. The coefficients of credit capital and household labour were 0.237 and 0.063 respectively implying that none of these two factors of production could lead to proportionate increase in banana output when their respective input levels are increased. Adding the two co-efficients gave the sum total of returns to scales of 0.3. This suggested that scaling up the inputs quantities in the production process by doubling only led to less than doubling the output. Thus, at current level of production technology, labour and credit capital exhibit decreasing returns to scale (DRS). This means that the production system demands high amounts of resources to only yield little or sub-optimal output. Bagamba *et al*. (2007) reported similar results of decreasing returns to scale. Thus, the research community must search for more resource-efficient utilizing technologies in order for banana producers to gain from credit use.

Results of farm-level distribution of technical efficiency (**Table 2**) showed that only 18.8% of the banana producers were operating at less than 80% of the production frontier. This meant that banana producers were highly efficient despite the factors of production exhibiting DRS. The finding suggests that since all these farmers are borrowers, attainment of efficient output that guarantees sufficient income for loan repayment from their own production, cannot be through technical skills improvement alone. It would most suitably be realized through introduction of new production technologies in the farming system. The average TE of banana producers in the sample stood at 0.872. The implication of this finding is that in the short-run and on average; it is only possible to increase yields of bananas by 22.8%. If the average-efficient farmer was to achieve the TE level of his/her most efficient counterpart, the average farmer would realize only 10.1% increase in the income streams (i.e., 1 - [0.872/0.97]). Application of the same calculation to the least technically efficient farmer revealed that the output would increase by 41.3% (i.e., 1 - [0.569/0.97]).

Table 2: Distribution of Technical Efficiency Estimates

Range of Technical Efficiency Distribution	Frequency	Absolute Percentage
< 0.60	1	1.1
0.60 – 0.699	4	4.4
0.70 – 0.799	12	13.3
0.80 – 0.899	26	28.9
0.90 – 1.000	47	52.2
Other Descriptive Statistics		
Efficiency Level of Least Efficient Producer	0.569	
Efficiency Level of Average Efficient Producer	0.872	
Efficiency Level of Most Efficient Producer	0.970	

Since output is directly related to income, it means that income changes are most likely to fall in the range of the above computations. Hence, it is important to identify factors responsible for technical inefficiency levels in the sample.

Determinants of Technical Inefficiency

Results of major sources of technical inefficiency **(Table 3)** revealed that the factors that would significantly reduce inefficiency were the plot size allocated to banana production, farming experience, and post-secondary education. On the other hand, the factors that were significantly worsening technical inefficiency were use of hired labour, use of agro-chemicals, and household size. The sex of household head was not significant any level, meaning it was not a major source of technical inefficiency.

Table 3: Sources of Technical Inefficiency

Variable	Co-Efficient	Standard Error	t-Value	p-Value
lnBan_Land	-0.22	0.03	-6.48	0.000
lnFar_Exp	-0.03	0.02	-1.73	0.088
Hrd_Labour	0.03	0.01	3.75	0.000
lnHH_Size	0.08	0.05	1.70	0.094
PostSec_Educ	-0.04	0.02	-1.77	0.080
DAgro_Chem	0.04	0.02	1.95	0.055
HH_Sex	0.002	0.02	0.08	0.935
Constant	0.42	0.08	5.42	0.000
F (7,82)	10.01			
Prob > F	0.000			
R-Square	0.46			
Adj R-Square	0.41			

In terms of marginal effects, a 1% increase in the plot size for banana and years of farming experience would reduce technical inefficiency by 0.22% and 0.03% respectively, holding all other factors constant. The variable of post-secondary education was a dummy, and the finding implied that households with heads who had attained post-secondary education were 4% more likely to reduce technical inefficiency than those households whose heads had not gone beyond secondary education. Although the percentage is low, its significance suggested that in the study area it is possible to reduce technical inefficiency through investment in education.

Most studies on technical efficiency in African agriculture have reported closely similar results on the major determinants of technical inefficiency as education, farm size, and experience (Kuwornu *et al*., 2013; Bagamba *et al*., 2007; Chirwa, 2007; Ogundele and Okuruwa, 2006).

Surprisingly, agro-chemical use in the study area was associated with more inefficiency. Literally, households applying agro-chemicals were 4% more likely to worsen technical inefficiency than those not using agro-chemicals at all. The causes of this finding are not very clear. However, some reasons can be thought of: one, these farmers could be over using the agro-chemicals, which could either be slowly contributing to reduced yields with declining soil fertility (possibly micro and macro fauna destroyed) or even damaging the crop's tissue. This seems to suggest a need for more farmer education on appropriate use of agro-chemicals. The co-efficient of hired labour (0.03) and size of households (0.08), implied that a 1% increase in any of these variables was associated with increase in inefficiency of 0.03% and 0.08% respectively, all else constant.

CONCLUSIONS AND POLICY RECOMMENDATIONS

The study was carried out in Sheema district an area that has tremendous introduction and integration of banana production in the cattle keeping economic activity. However, this kind of production has come with increased demand for agricultural credit in the study though with high a rate of repayment default. Consequently, a study was undertaken to examine credit use and technical efficiency for the banana producers. The stochastic production frontier model revealed that 90% of the total variation in production efficiency was arising from technical inefficiency. Estimated production elasticities revealed that employing credit capital and labour did not lead to proportionate increase in output and consequently the technology exhibited decreasing returns to scale. Results also revealed that the average efficient and the least efficient farmers would be able to increase their output and income streams by 22.8% and 41.3% respectively if they used practices of the most efficient farmer in the sample. Banana producers' technical inefficiency can minimized by more education, increasing plot sizes allocated to banana, and farming experience. However, the factors, which worsened this inefficiency, were agro-chemical use, hired labour and household size.

Since post-secondary education reduces inefficient production derived from credit use, government should invest more in education. Policy interventions should also focus on former and informal training to banana producers on appropriate credit management, enterprise budgeting/costing and records management. The considerable loss in farm profits due to agro-chemicals, means deficiency in technical skills. Hence, the agricultural extension programme should put a lot of emphasis on training farmers on optimal application, efficient application techniques and appropriate agro-chemical selection to reduce wastage, crop burn and soil fertility loss. Lastly, the research community should revisit productivity-enhancing technologies to establish those that are most suited to intensive systems with credit use.

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APPENDICES

Appendix

Table 4: Determinants of Credit

Explanatory Variable	Dependent Variable: lnCredit		
	Coeff	t-Value	p-Value
lnBan_Land	0.837	3.89	0.000
Hrd_Labour	0.119	3.43	0.001
lnFar_Exp	-0.077	-0.66	0.510
lnHH_Age	0.944	2.09	0.040
DAgro_Chem	0.165	2.05	0.043
DEduc	0.417	3.89	0.000
Cons	9.039	5.92	0.000
Observation	90		
R-Square	0.564		
Adj R-Square	0.533		
F(6, 83)	17.9		
Prob>F	0.0000		